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REDUCTION OF DWARF MISTLETOE WITH THE PLANT GROWTH REGULATOR ETHEPHON

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ABSTRACT

Ethephon (Florel^{R}), an ethylene-releasing plant growth regulator, was applied to female dwarf mistletoe shoots on 3 California conifers: Arceuthobium campylopodum on Pinus ponderosa (Boggs Mountain Demonstration State Forest) and P. jeffreyi (Latour Demonstration State Forest) and Arceuthobium americanum on Pinus contorta (Latour Demonstration State Forest) in August and September, 1988. Ethephon at a rate of 2500 ppm with a surfactant (Ortho X-77), and water with Ortho X-77 as the control, was applied using a backpack sprayer to about 30 infections of each host-parasite combination. After 5 weeks abscission rates ranged from 96% to 100% in the treatments compared to no shoot abscission in the controls. There was some damage to host tree needles, particularly in P. contorta.

INTRODUCTION

Dwarf mistletoes are the most widespread forest disease in California. It has been estimated that 2.3 million acres of commercial forest land in the state are infested with dwarf mistletoe, resulting in an annual loss of 100 million cubic feet (DeNitto, 1987). Dwarf mistletoe is also a problem in high value sites where it slows tree growth, predisposes trees to insects and diseases, and impairs visual quality.

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Control of dwarf mistletoe centers on silvicultural methods of removing infected branches or trees in order to prevent infection of uninfested stands. On September 1, 1987 the Environmental Protection Agency approved the use of a growth regulating chemical named ethephon (Florel®) for use in reducing the spread of dwarf mistletoe. Ethephon is not yet registered in California. The state requires in-state efficacy data for registration. This test provides some of the needed data.

Ethephon accelerates mistletoe shoot abscission, but does not appear to affect the internal tissues of the parasite. By removal of the seed-bearing shoots, however, seed dispersal and spread of the parasite is delayed 3 to 5 years (average time for seed development). This delay could allow time for uninfected regeneration to become established under infected host trees prior to removal of the overstory or, reduce an anticipated increase in infection levels of trees of all age classes that are retained. Because of the expense and difficulty of large scale application of ethephon, treatment is recommended only in high value areas (campgrounds, home sites, administrative sites, etc.) and has limited or no use in commercial stands (Johnson and Hawksworth, 1988a).

To date, most research on ethephon has been done on lodgepole pine dwarf mistletoe (A. americanum) in Colorado; black spruce dwarf mistletoe (A. pusillum) in Minnesota; southwestern dwarf mistletoe (A. vaginatum) in Colorado and New Mexico; and Douglas-fir dwarf mistletoe (A. douglasii) in Oregon. Shoot abscission rates ranged from 70% to 100% for these tests using ground based equipment (Johnson and Hawksworth, 1988b).

This test assessed the efficacy of using ethephon to remove nearly mature fruits of western dwarf mistletoe (A. campylopodum) and lodgepole pine dwarf mistletoe (A. americanum) from infected hosts.

METHODS

Ethephon field trials are being conducted throughout the western United States. To make results from these tests comparable the Forest Service issued suggested standards for ethephon field tests. The experimental design is based on these guidelines (Johnson and Hawksworth, 1988b).

Two sites with moderate to heavy dwarf mistletoe infection on two Demonstration State Forests (D.S.F.) were selected as listed below:

Location	Mistletoe/host	Treated		Control	
		Trees	Branches	Trees	Branches
		No.	No.	No.	No.
Boggs Mountain D.S.F.					
	Western dwarf mistletoe - ponderosa pine (Arceuthobium campylopodum - Pinus ponderosa)	19	30	15	30

Latour D.S.F. Western dwarf mistletoe - Jeffrey pine (Arceuthobium campylopodum - Pinus jeffreyi)	15	30	18	30
Latour D.S.F. Lodgepole pine dwarf mistletoe - lodgepole (Arceuthobium americanum - Pinus contorta)	14	30	15	30

The ponderosa pine stand at Boggs Mountain D.S.F. is located near Cobb, California at an elevation of 2000 feet. The Jeffrey and lodgepole pine stands at Latour D.S.F. are located 40 miles northeast of Redding, California. The sites are at between 6000 and 7000 feet.

Two treatments were evaluated: Ethephon at 2500 ppm with 0.1% Ortho X-77 (surfactant) in water, and water only with 0.1% Ortho X-77. Ethephon and surfactant were measured and mixed just prior to use to prevent pH change and conversion of the material to ethylene. Ethephon was applied approximately 4 weeks prior to mistletoe fruit maturity.

Infections were randomly selected in the lower crowns of pines. An infection equals one plant comprised of numerous shoots. Each infection was labelled with a numbered metal tag and each tree was labelled with a metal tag at the base. Shoots on each infection were counted and recorded. Photographs were taken of representative infections.

On August 31, 1988 (Boggs Mountain D.S.F.) and September 1, 1988 (Latour D.S.F.) ethephon was applied to run-off with a backpack sprayer. Weather in both locations was sunny, approximately 85 degrees F., with no wind.

Abscission rate was evaluated 5 weeks after ethephon application. Numbers of shoots present in ethephon treated infections were determined. The number of shoots remaining on control treated infections was estimated (see Table 1). Upon visual examination, if no change in number or appearance of shoots was observed, number of shoots was assumed to have remained the same. Since ethephon does not kill the internal dwarf mistletoe tissues, trees will be examined yearly and mistletoe resprouting and fruit production noted.

RESULTS AND DISCUSSION

Abscission rates ranging between 96-100% were achieved in all species tested (see Table 1.) These results agree with other work done with ethephon on dwarf mistletoe which has found that as long as spray coverage is complete, shoot abscission rate is high (Johnson and Hawksworth, 1988b). The estimation of the control treated shoots may allow for a small error in the estimation of natural and surfactant/water-induced abscission. This is thought to be insignificant in

determining whether ethephon causes shoot abscission. Other tests have shown that surfactant and water when sprayed by hand do not cause high rates of shoot abscission (Johnson and Hawksworth, 1988b).

In the ethephon treated lodgepole pine (P. contorta) there was some browning of host needles, particularly those that were inadvertently sprayed with ethephon due to their proximity to a dwarf mistletoe infection. A lower concentration of ethephon or different season of application should be tried to minimize this injury to host. If chemical application is made by hydraulic spray of whole trees, both desirable or undesirable understory vegetation (shrubs, trees, grasses, and weeds) may be affected. Whole tree spraying may also cause defoliation or browning of needles.

Our test demonstrated that ethephon does accelerate female dwarf mistletoe shoot abscission when sprayed by hand directly onto infections. This method of treatment is limited to small trees, to infections that can be reached on a ladder, or are otherwise accessible. The next logical test is to evaluate control when entire trees are sprayed with a hydraulic sprayer. Additional evaluations of ethephon are also needed to determine the best concentration for various host-parasite combinations and the most efficacious means of applying the chemical.

Table 1. Numbers and percent reduction of dwarf mistletoe shoots on ponderosa pine, Jeffrey pine and lodgepole pine before and 5 weeks after treatment with 2500 ppm Ethephon/surfactant (treated) compared to water/surfactant (control).

Mistletoe - Host	Treatment	Number of shoots		% reduction
		Before	After	
Arceuthobium campylopodum - Pinus ponderosa	Treated	1053	6	99%
	Control	770	770	0%
Arceuthobium campylopodum - Pinus jeffreyi	Treated	599	24	96%
	Control	890	890	0%
Arceuthobium americanum - Pinus contorta	Treated	897	0	100%
	Control	720	720	0%

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